EFFECT OF NUTRIENT DENSE SUPPLEMENT AND EDUCATIONAL MODULE ON NUTRITIONAL STATUS OF CHILDREN LIVING IN SLUM AREAS OF AGRA

A

Synopsis

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1.0. Introduction

1.1. Malnutrition

According to World Health Organization (2018), "Malnutrition refers to deficiencies, excesses or imbalance in a person's intake of energy or nutrients. The term malnutrition addresses three broad groups of conditions:

- undernutrition, which includes wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age),
- micronutrient-related malnutrition, which includes micronutrient deficiencies (a lack of vitamins and minerals) or micronutrient excess,
- overweight, obesity and diet related non communicable diseases (such as heart disease, stroke, diabetes and cancer)."

Children are vulnerable segment of population. They are the future of a nation. Their health is nation's wealth (Shamanewadi & Kondagunta, 2016). Nutrition plays a very important role in growth and development of children (Sharma et al., 2017). Undernutrition becomes a major health problem in India. It silently destroys the future productivity of nation and increases the economic burden of society (Joshi et al., 2016). Globally, 52 million children under 5 years of age are wasted, 17 million severely wasted and 155 million stunted. Undernutrition causes nearly 45 percent of deaths in under five years children (WHO, 2018).

1.2. Slum area

Census of India (2011) defines "all clusters of 20-25 or more households, having no roofs or non-concrete roofs, and not having any facility of drinking water, toilets or drainage is considered as slums". Slum population is increased about 3% in 2011 census (26.31%) in compare to 2001 census (23.5%) in India. Nine larger states of India namely; Tamil Nadu, Madhya Pradesh, Uttar Pradesh, Karnataka, Maharashtra,

Andhra Pradesh, West Bengal, Rajasthan and Gujarat enumerated more than 81 percent slum population and 1955 slum towns.

1.3. Prevalence of undernutrition in slum areas of India

- Gautam et al. (2018) conducted a study on children living in slum areas of Kanpur and found that prevalence of stunting and wasting were 31.28 percent and 6.15 percent respectively.
- Aggarwal & Srivastava (2017) studied the prevalence of undernutrition among children of slum areas of Lucknow and found that 34.4 percent children were underweight, 58.8 percent were stunted and 17.6 percent were wasted.
- Nutritional status of children were assessed in slum areas of Odisha, and found that 55.3 percent were underweight, 75 percent were wasted and 42 percent were stunted (Sethy et al. 2016).
- Shrivastava et al. (2015) assessed the nutritional status of children living in slum area of Sagar and found that 8 percent and 3 percent children were suffered with mild and moderate undernutrition.
- A study was conducted by Mamulwar (2014) in slum areas of Pune on children and found that 34.3 percent children were underweight, 58.7 percent were stunted and 16.9 percent were wasted.
- In the slum areas of Mumbai, According to WHO z scores standards 35 percent children had low weight for age, 17 percent had low weight for height and 47 percent had low weight for age (Das et al. 2012).

1.4. Nutrient requirement for children

Children need a wide range of nutrients to perform various functions of the body and leads to healthy life. The nutrients include carbohydrates, proteins, fats, vitamins and minerals. These nutrients are present in our food. A balanced diet provides all the nutrients in proper proportions. National Institute of Nutrition (2011) has defined nutrients are as follows:

Carbohydrates

Carbohydrates are energy yielding substances. They provide energy of 4 Kcal/g. They are divided in two forms: Simple and Complex carbohydrates. Simple carbohydrates are found in fruits, vegetables, honey, sugar, milk and milk products whereas complex carbohydrates are found in cereals, millets, pulses and root vegetables. Fibre rich diets help to reduce glucose and lipids in blood. They increase the bulk of stool. Complex carbohydrate rich diets are beneficial for human health.

Proteins

Proteins are essential macro nutrient for human body. They provide energy 4 Kcal/g. They help to repair tissues. They play a vital role in growth of children. They form the important component in muscles and tissues. Animal proteins have good quality of proteins. They are present in milk, meat, fish and egg. Plant proteins are present in pulses and legumes. They have low content of essential amino acids while animal proteins have high content of essential amino acids.

Fats

Fats are major component of diet. It plays a number of functions in the body. They provide energy of 9 Kcal/gm. Diet contains two kinds of fats: Visible fats and invisible fats. Visible fats are derived from animal fats like butter, ghee. Invisible fats are derived from vegetables fats like groundnut, mustard, coconut etc. They help the body to absorb some vitamins like Vitamin A, D, E & K are fat soluble.

Vitamins

Vitamins are organic substances present in small amounts in many foods. They are require for carrying out many vital functions of the body like maintenance of skin, eye, blood and mucous membrane. Vitamin A, D, E & K are fat soluble while vitamin C and B –complex such as thiamine (B_1), riboflavin (B_2), niacin, pyridoxine(B_6), folic acid and cyanocobalamin (B_{12}) are water soluble.

Minerals

Minerals are perform many important functions in the body. They are inorganic elements. They are classified into two groups: Macro minerals and Micro minerals. Macro minerals are sodium, potassium, calcium, phosphorous, magnesium and sulphur, while zinc, copper, selenium, molybdenum, fluorine, cobalt, chromium and iodine are micro minerals. They help to build tissues and regulate body fluids.

Table: 1: ICMR (2010) has given the recommended dietary allowances for children:

Nutrients	**4-6 years (Boys +Girls)**	**7-9 years (Boys +Girls)**	**10-12 Years**	
			Boys	**Girls**
Energy Kcal/day	1350	1690	2190	2010
Protein gm/day	20.1	29.5	39.9	40.4
Fat gm/day	25	30	35	35
Calcium mg/day	600	600	800	800
Iron mg/day	13	16	21	27
Vitamin A µg/day	400	600	600	600
Thiamin mg/day	0.7	0.8	1.1	1.0
Riboflavin mg/day	0.8	1.0	1.3	1.2
Ascorbic acid mg/day	40	40	40	40
Dietary folate µg/day	100	120	140	140
Vitamin B12 µg/day	0.2-1.0	0.2-1.0	0.2-1.0	0.2-1.0

Source: ICMR, (2010)

Table: 2: Balanced diet for children (Number of portions)

Food Groups	g/portion	4-6years	7-9years	10-12 years	
				Boys	Girls
Cereals & Millets	30	4	6	8	10
Pulses	30	1	2	2	2
Milk(ml) & milk products	100	5	5	5	5
Roots & tubers	100	1	1	1	1
Green leafy vegetables	100	0.5	1	1	1
Other vegetable	100	1	1	2	2
Fruits	100	1	1	1	1
Sugar	5	4	4	6	6
Fat/oil (visible)	5	5	6	7	7

Source: NIN (2011)

1.5. Nutrient dense supplement

One way to bridge the food gap leading to undernutrition that is the most wide spread among children in the developing countries are to introduced low cost, culturally acceptable nutrient dense supplement prepared from locally available sources and traditional processing methods. Even though several proprietary supplementary foods are marketed in India, they are too expensive for economical challenged groups. As the importance of nutrient dense supplement in preventing undernutrition is now well recognized, there is a need for development of nutrient dense supplement.

1.6. Importance of nutrient dense supplement

Gupta et al. (2015) developed a nutrient dense supplement are highly nutritious, being a good source of calcium, iron, fiber, vitamins and minerals. Formulation of products incorporated nutrient dense supplement increases the nutritive value of diet and include in daily diet of children for improving the

nutritional status of children. The developed value added products are good supplement to meet the nutritional requirement of growing children, which provides good amount of protein, fat, iron and calcium (Punia & Gupta, 2009). Micronutrient dense product for combating micronutrient deficiencies among children and found that addition of dehydrated greens improve the nutritional quality of diet (Gupta & Prakash, 2011). Composite flour was developed by locally available inexpensive sources. Products were developed with incorporation of composite flour. Energy, protein, fat, crude fiber, carbohydrate, iron, calcium and phosphorous were increased with the incorporation of composite flour in daily food preparations (Kumari et al., 2016).

1.7. Nutrition education

Nutrition education is a powerful tool to improve the nutritional status of children. When it is planned and delivered appropriately to the target population. It brings the desirable changes in nutritional knowledge, attitude and practices of mothers and thus ultimately brings about a favourable changes in nutritional status of children. A lack of food is not the sole cause of undernutrition. Lack of knowledge about the nutrition is responsible factors for undernutrition. If the mothers are educated by using the educational module, a large proportion of undernutrition can be avoided (Marathe, 2000).

Conclusion

Undernutrition is one of the reasons behind the high child mortality rates in developing countries. Undernutrition, the condition resulting from faulty nutrition, weakens the immune system and causes significant growth and cognitive delay. The present scenario of nutritional status of the children in India is very unsatisfactory.

The present study is therefore planned to develop a nutrient dense supplement for undernourished children and educational module for their mothers. Nutrient dense supplement coupled with nutrition education is need of hours to break the intergenerational cycle of undernutrition.

2.0. Review of literature

Relevant literature of the present study has been collected and presented in following headings:

- Nutritional status of slum areas children
- Nutrition education
- Development of Nutrient dense supplement
- Supplementation of developed products

Studies related to	S.no.	Year	Name of the researcher	Title	Result
2.1. Nutritional status of slum areas children	1.	2019	Huey et al.	Prevalence and Correlates of Undernutrition in Young Children Living in Urban Slums of Mumbai, India: A Cross Sectional Study	Children living in slum areas of Mumbai were assessed and found that 31.2 percent were stunted, 25.1 percent were wasted and 9.0 percent were underweight.
	2.	2018	Meshram, & Khobragade	Socio-demographic determinants of malnutrition among school going children in an urban slum area of central India with special reference to nutritional anemia	As per the WHO growth standards, nutritional status of children were assessed and found that 17.17 percent children were underweight and 22.99 percent were stunted which indicates chronic malnutrition.
	3.	2016	Kumar & Deswal	An epidemiological study of protein energy malnutrition among children	Nutritional status of children were assessed by using Indian Academy of Pediatrics standards and found that 37.73 percent males and 50.0 percent females were suffered with PEM. More females were suffered

				below six years' age in an urban slum of Gurgaon, Haryana, India	with PEM than males.
2.2. Nutrition education	3.	2018	Edith and Priya,	Knowledge, attitude and practice (KAP) survey on dietary practices in prevention of malnutrition among mothers of under – five children	Only 56% and 58% of mothers had moderately adequate knowledge and moderately adequate practice regarding dietary practices in prevention of undernutrition. Favourable attitude towards dietary practices in prevention of undernutrition was found among 56% of mothers. After collecting the data, educational module on prevention of undernutrition was developed for educating the mothers to improve the knowledge, attitude and practices, which will help to reduce the rate of undernutrition.
	4.	2018	Manohar et al.	Assessment of Knowledge, Attitude and Practice of Mothers with Severe Acute Malnutrition Children Regarding Child Feeding	A study was conducted on 120 mothers 57.5% have adequate knowledge followed by 30% have moderately adequate, 12.5% have inadequate knowledge. But in practices only 33.33% mothers showed adequate feeding practices, remaining 51.66% showed moderately adequate practices, 15% showed inadequate feeding practices and 35.83% showed favourable attitude, 29.16% showed moderately favourable, 35% showed negative attitude towards the child feeding. After analyzing the data, gaps were identified in knowledge and practices of mothers regarding child feeding. This study emphasizes the need to improve the knowledge and practices through nutrition

					education.
	5.	2015	Lodha	Impact of nutrition education on infant feeding practices and knowledge, attitude, practices of mothers regarding complementary feeding	Nutritional knowledge and attitude were found better in experimental group mothers due to nutrition education as compared to control group mothers. Hence it is concluded that nutrition education significantly improves the nutritional knowledge, attitude and practices mothers.
2.3. Development of Nutrient dense supplement	6.	2016	Kumari et al.	Development and sensory optimization of low cost micronutrient rich nutritious product by using locally available food resources	Development of composite flour from wheat flour/Soya flour/moong dal flour/ragi flour and groundnut flour. It has high nutritional value. The incorporation of composite flour enhances the nutritional quality of food preparations. Composite flour being good source of proteins, iron, calcium, phosphorous and energy which is incorporated in the daily diets of vulnerable sections of population.
	7.	2012	Dubey and Saxena	Preparation of Value Added Weaning Food Products for Infants using Flours of Germinated Cereals and Pulses.	Four supplementary foods namely panjiri, sweet porridge, ladoo, sweet and salty biscuits were prepared by different combinations of germinated wheat, mung and bajra flour. The results revealed an increase in vitamin C and B complex vitamins in the developed weaning foods when compared with control samples.
2.4. Supplement-ation of developed products	8.	2016	Prasad	Impact of ready-to-eat supplementary foods formulated from germinated cereal-pulse mix	Supplementation of developed products reported significant ($p<0.01$, $p<0.05$) increase in the intake of all macro and micronutrients. Significant ($p<0.01$) increase in weight, body mass

				and potato flour on the nutritional status of malnourished children	index, mid upper arm circumference after supplementation. Significant ($p<0.01$) increment in hemoglobin was observed in the subjects of experimental group after supplementation.
	9.	2014	Guddad	Nutritional status and strategy to combat malnutrition among preschool children of rural Dharwad	Protein energy mix was supplemented to preschool children in the form of laddu to provide 460 Kcal of energy and 11g of protein for 90 days, an improvement in anthropometric measurements like height, weight, mid upper arm circumference, head and chest circumference were observed which inturn reduced the episodes of morbidity. Cognitive skills of children increased significantly after supplementation.

3.0. An overview of research

3.1. Need of the study

Undernutrition is a major problem among children. According to NSS 69th round (2012), report about 33 thousand slums are estimated to be existing in India, 30 percent are located in open spaces, 23 percent along 'nallahs' and drains and 9 percent are near railway lines. With rapid growth of slums undernutrition is widely prevalent among children living in slum areas. Children are always at a high risk of undernutrition and other health problems in slum areas (Munesh, et al. 2011). Nutritional status of children in Agra, According to National Family Health survey (2015-16) report prevalence of stunting, wasting and underweight were found 44.7 percent, 14.9 percent and 34.8 percent respectively. Children require adequate intake of nutritious food for physical and mental development. A mother is the principle provider of the primary care that her child needs. Nutritional status of children depends on her nutritional

knowledge, attitude and practices (Kaur, 2015). Mothers have poor nutritional knowledge. Nutrition education strategies is required for mothers of children (Tubid, 2015).

The present study is therefore planned to tackle the undernutrition by developing nutrient dense supplement and educational module. A nutrient dense supplement is a food based strategies to reduce the undernutrition among children living in slum areas. It will be prepared by using locally available sources and traditional processing methods. It will help to improve the nutritional quality of diet. Nutrition education is planned for the mothers of undernourished children. Educational module will be prepared for nutrition education. This is an effective approach for desirable changes in mother's nutritional knowledge, attitude and practices, which will help to improve the nutritional status of children. Nutrition education and supplementation of nutrient dense supplement is an effective combination to improve the nutritional status children.

3.2. Statement of the problem

"Effect of nutrient dense supplement and educational module on nutritional status of children living in slum areas of Agra."

3.3. Objectives of the study

- To assess the nutritional status of children.
- To assess the nutritional knowledge, attitude and practices of mothers of children.
- To develop a nutrient dense supplement and its products for children.
- To develop educational module and impart nutrition education to mothers of children.
- To evaluate the effect of nutrient dense supplement on nutritional status of children.
- To evaluate the effect of educational module on nutritional knowledge, attitude and practices of mothers of children.

3.4. Hypothesis of the study

$H_0$1: There is no significant effect of nutrient dense supplement on nutritional status of children living in slum areas of Agra.

H_a1: There is significant effect of nutrient dense supplement on nutritional status of children living in slum areas of Agra.

$H_0$2: There is no significant effect of educational module on nutritional knowledge, attitude and practices of mothers.

H_a2: There is significant effect of educational module on nutritional knowledge, attitude and practices of mothers.

3.5. Operational definitions

Nutrient dense supplement – Nutrient dense supplement refers to micronutrient and macro nutrient dense supplement, which is developed by locally available sources and traditional processing methods.

Educational module –Educational modules refers to a package of instructions on key aspects of nutrition, which provide guidance to reduce the problem of undernutrition at family and community levels.

Nutritional Status – Nutritional status is current status of children related to their dietary pattern and anthropometric measurements.

Slum area - A slum is an urban informal overcrowded, residential settlement near a city or town characterized by substandard housing, sanitation and infrastructure.

3.6. Variables of the research

Independent variables

- Age

- Gender
- Educational profile
- Type of family
- Numbers of children
- Occupation of father
- Occupation of mother
- Family income
- Present nutritional status

Dependent variables

- Nutritional Knowledge, attitude and practices
- Anthropometric measurements
- Dietary pattern

3.7. Methodology

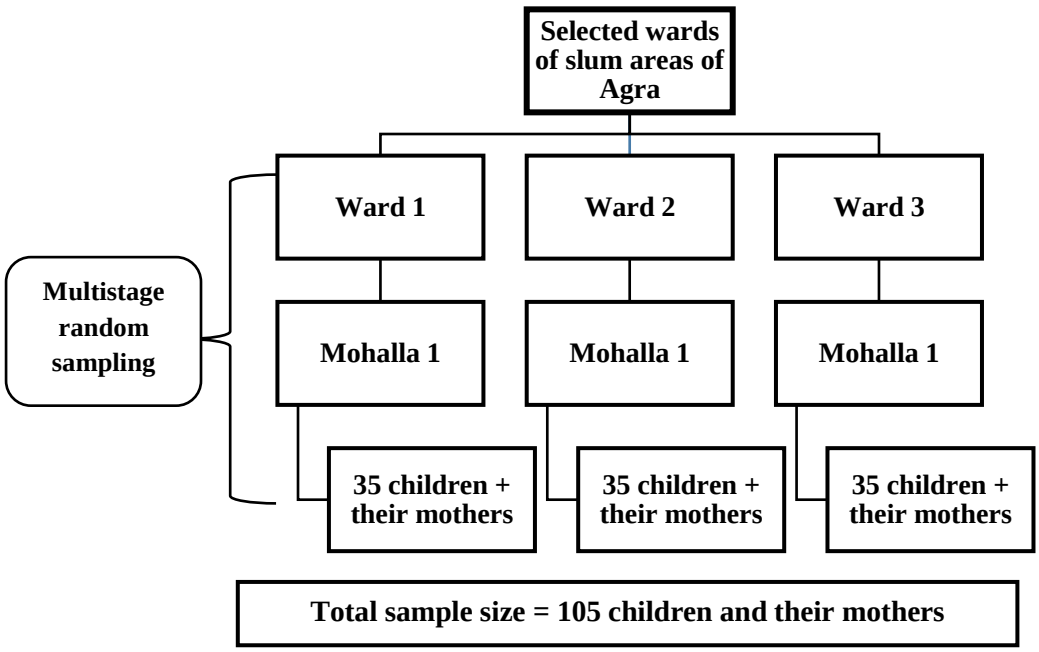
3.7.1. Research design

- The present research is an experimental research design.

3.7.1.1. Sampling design

3.7.1.1.1. Selection of sample:

- Agra will be selected conveniently for the present study.
- Multistage random sampling techniques will be used to select the research area.
- Agra has 90 wards, out of these wards, three wards will be selected by systematic random sampling.
- Each ward of slum area has its own mohallas, one mohalla will be selected randomly by lottery method from each ward.



- List of children will be made by door to door visit.
- Nutritional status will be assessed by using anthropometric measurements (height, weight, Body Mass Index).
- WHO growth standards will be used to define undernutrition.
- After analyzing the anthropometric measurements, list of moderately undernourished children will be prepared.
- Thirty five moderately undernourished children will be selected randomly by lottery method from each mohallas.
- After the selection of moderately undernourished children, their mothers will be included in the present study.

3.7.1.1.2. Criteria for sample selection

- Children aged 6 to 12 years will be included.
- Both male and female children will be included.
- The children should be resident of the selected slums.

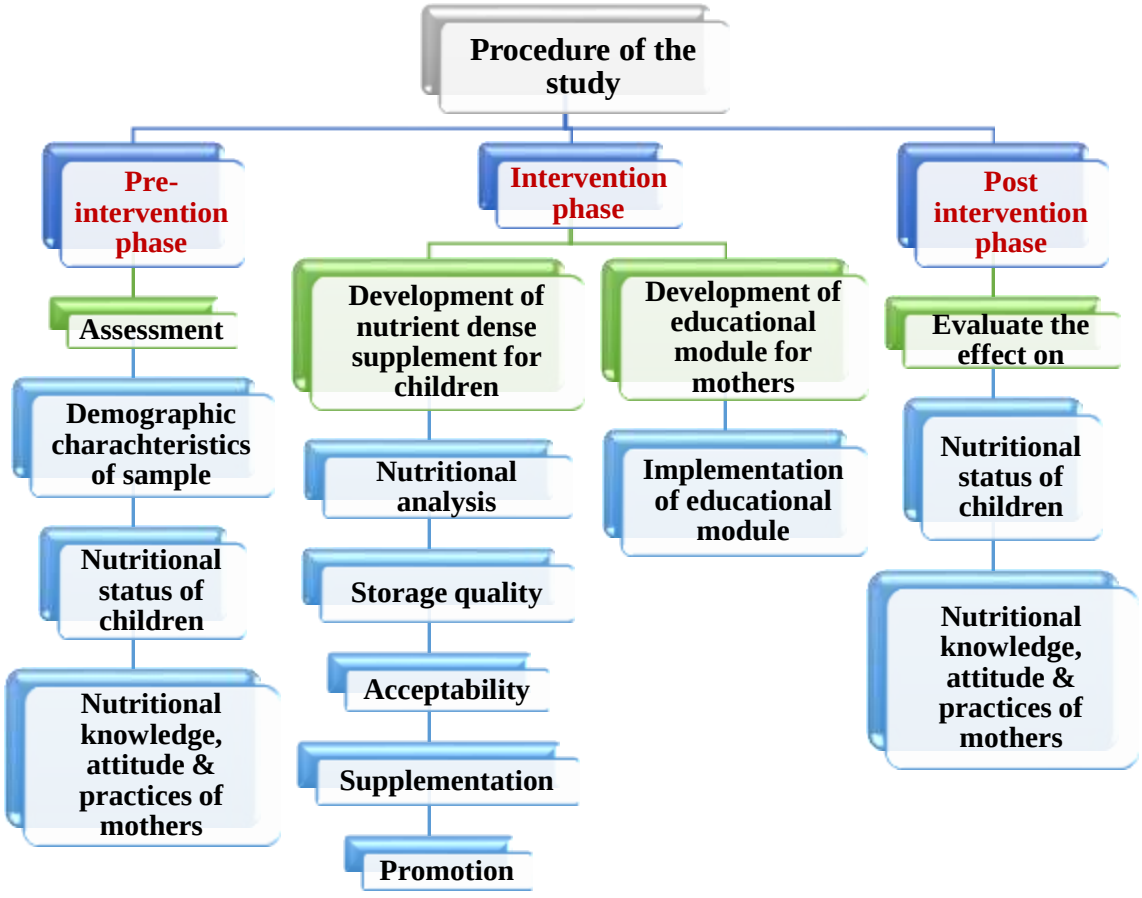
- If the family has more than one child, only youngest child will be included.
- If the children have no mother, their care taker will be included.
- Willingness and co-operation of sample is prime important for the study.

3.7.1.2. Operational design

3.7.1.2.1. Tools for data collection

S. No.	Name of Tools	Type of tools	Components
1.	Assessment of Demographic profile of sample	Self-prepared schedule	Age, gender, educational status, type of family, no. of children, occupation of father, working status of mother, family income
2.	Assessment of Nutritional knowledge	Self-prepared schedule	➢ Balanced diet ➢ Nutrients and their sources ➢ Nutritional deficiency and prevention ➢ Health & hygiene
3.	Assessment of Nutritional attitude	Self-prepared schedule	
4.	Assessment of Nutritional practices	Self-prepared schedule	

S.No.	Name of tool	Standard Methods	Components	Tools
1.	Assessment of anthropometric measurement of children	Jelliffe (1966)	• Weight • Height	• Digital weight scale • Stadiometer
2.	Assessment of Dietary pattern of children	FAO (2018)	• 24 hour dietary recall • Food frequency questionnaire (FFQ)	• Standardized cups • Standardized spoons • Standardized glass



3.7.1.2.2. Procedure of the study

Phase: 1: Pre- intervention phase

Assessment

- Assessment of demographic characteristics of sample.
- Assessment of anthropometric measurements (height, weight and BMI) of children.
- Assessment of dietary pattern (24 hour dietary recall and food frequency questionnaire) of children.

- Assessment of nutritional knowledge of mothers
- Assessment of nutritional attitude of mothers
- Assessment of nutritional practices of mothers

Identification

- Nutritional status of children will be identified.
- Gaps will be identified in nutritional knowledge, attitude and practices of mothers.

Phase: II: Intervention phase

A. Development of nutrient dense supplement

Criteria for development of nutrient dense supplement

- Prepare by using the combination of cereals, millets, pulse, green leafy vegetable and other vegetables
- Locally available sources
- Nutrient content : Rich in energy, protein, iron and calcium
- Low cost

Nutritional analysis of nutrient dense supplement

- Nutrient dense supplement will be analyzed for moisture, protein, fat, ash, crude fiber and carbohydrate.
- Iron and calcium will also be analyzed.

Storage quality

- The stored sample will be analyzed for sensory qualities in the beginning and fortnightly during three months of storage.

Acceptability

- Products will be developed by nutrient dense supplement.
- Sensory evaluation of developed products will be conducted.

Supplementation

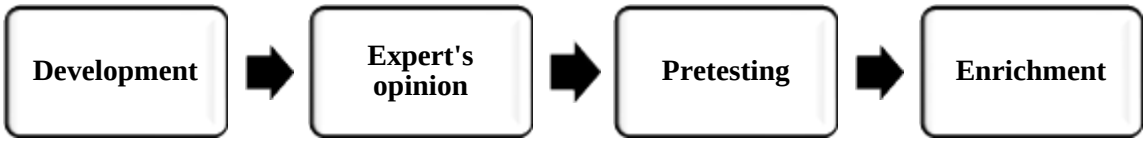
- Supplementation of nutrient dense supplement will be conducted for six months.

Promotion of nutrient dense supplement

- Nutrient dense supplement will be promoted during the nutrition education sessions among the mothers of selected sample.
- Mothers will be encouraged to prepare nutrient dense supplement at home.

B. Development of educational module for the mothers of children:

Steps for development of educational module:



- **Development:** Module will be developed on the following topics:
  - Balanced diet
  - Nutrients and their sources
  - Nutritional deficiency and prevention
  - Health & hygiene
- **Expert's opinion:** The developed module will be analysed by experts in the field of nutrition and extension education. The module will be refined based on their recommendations.

- **Pre-testing**: To test the applicability and specificity of the content of module, it will be pre-tested with a group of 15 mothers of children. They will be asked to give their feedback on the difficulties to understand the content of module.
- **Enrichment:** The content of the module will be enriched based on the identified difficulties during the pre-testing.

C. Implementation of nutrition education activities

Forming group and building rapport

- Area wise groups of mothers will be formed
- Rapport building activities will be conducted before the sessions.
- Educational module will be implemented on the mothers of children.

Duration of nutrition education

- Nutrition education sessions will be conducted for 3 months.

Conducting nutrition education sessions with the help of module

- Nutrition education sessions will be carried out in the sites convenient to mothers of children.
- Nutrition education will be conducted through visuals aids.
- Home visits will be conducted for the reinforcement of nutrition messages.

Phase: III: Post intervention phase

- Evaluate the effect of nutrient dense supplement on nutritional status of children on the following aspects:

- Assessment of anthropometric measurements (height, weight, BMI) of children.
- Assessment of dietary pattern (24 hour dietary recall and food frequency questionnaire) of children.

- Evaluate the effect of educational module on the mothers of children on the following aspects :

- Assessment of nutritional knowledge of mothers
- Assessment of nutritional attitude of mothers
- Assessment of nutritional practices of mothers

Phase: IV: Follow up

- To assess the stability of improved nutritional knowledge, attitude & practices of mothers.
- To assess the use of nutrient dense supplement in the diet of children.

3.7.1.2.3. Statistical design

- Percentage, mean, and Standard deviation will be calculated.
- The paired‘t’ test will be used to test the significance of mean difference between pre and post values of intervention study.
- Other statistical methods will be decided according to the nature of the data obtained.

4.0. Ethical consideration

- The research permission will be taken by the ethical committee of Dayalbagh Educational Institute, Agra.
- An informed written consent will be obtained from the parents of all the subjects who will participate in the study and they will be explained in detail the study protocol.

5.0. Delimitation of the research

- The present study will be carried out in Agra.
- The present study will be conducted in three mohallas of Agra.
- The present study will be conducted on 6-12 years aged children living in slum areas.

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